What is claimed is:

1. A channel equalizer for restoring an original signal from a digital TV receiving signal having passed through a channel, comprising:

a channel estimation unit for estimating a finite impulse response estimation value of a channel by estimating an impulse response of a transmission channel from a received signal having passed through the channel; and

a channel distortion compensation unit for compensating for the channel distortion of the received signal by using the time impulse response estimated in a frequency domain after converting the received signal and the estimated impulse response into the frequency domain, respectively, and for converting the received signal into a time domain again.

2. The channel equalizer as claimed in claim 1, wherein the channel estimation unit comprises:

a cross-correlation value generator for detecting a training time and calculating a cross-correlation value p(n) between a training sequence having passed through the channel during the training time and a predetermined training sequence at a receiver;

an instantaneous estimation unit for estimating an instantaneous channel value

$\hat{h}_i(n)$, (where $n = -N_{a,}\ -N_a + 1,\ \cdots,\ 0,\ \cdots,\ N_c - 1,\ N_c$) by performing a matrix multiplication of coefficients of an inverse matrix R^{-1} of an autocorrelation matrix of a predetermined training signal and cross-correlation values; and

an estimation channel filter for calculating a mean value between a pre-stored estimation channel $\hat{h}(n-1)$ of a previous frame and a present instantaneous channel being outputted from the instantaneous channel $\hat{h}_i(n)$ estimation unit and outputting the mean value.

3. The channel equalizer as claimed in claim 2, wherein the cross-correlation value generating unit comprises:

a plurality of delayers, connected in serial as much as a training signal, for delaying the input signal sequentially;

a plurality of multipliers for multiplying outputs of the respect delayers by respect corresponding training signals t_i, $0 \le i \le L-1$; and

an adder for adding all the output of the respect multipliers and outputting the cross-correlation value p(n).

4. The channel equalizer as claimed in claim 2, wherein the instantaneous channel estimation unit comprises:

a ROM table for storing a coefficient of an inverse matrix R^{-1} of the autocorrelation matrix of the training sequence and outputting respect column values of R^{-1} in parallel;

a plurality of delayers, connected in serial, for delaying the cross-correlation value p(n) sequentially;

a plurality of multipliers for performing a matrix multiplication of the outputs of the respect delayers with the respect outputs of the ROM table; and

an adder for adding the outputs of the respect multipliers and outputting the instantaneous channel value $\hat{h}_i(n)$.

5. The channel equalizer as claimed in claim 1, wherein the channel distortion compensation unit comprises:

a first Fast Fourier Transform unit for transforming the received signal from the time domain to the frequency domain;

a second Fast Fourier Transform unit for transforming the channel impulse response estimated in the channel estimation unit from the time domain to the frequency domain;

a ROM for storing inverse values of the channel impulse response transformed into the frequency domain in a form of table;

a complex multiplier for correcting the distortion of the received signal in the frequency domain outputted from the first

Fast Fourier Transform unit by using a signal outputted from the ROM; and

an inversed Fast Fourier Transform unit for inverse-converting the signal in the frequency signal domain outputted from the complex multiplier.

6. The channel equalizer as claimed in claim 1, wherein the channel distortion compensation unit comprises:

a 1x $\rightarrow$ 2x converter for enabling 2x Fast Fourier Transform by superposing a data block of a signal being received on a previous data block;

a zero padding machine for padding the estimated channel impulse response $\hat{h}(n)$ in the channel estimation unit with 0 (zero) to be suitable a 2x Fast Fourier Transform block;

a first Fast Fourier Transform unit for converting a 2x data block of the 1x $\rightarrow$ 2x converter into the frequency domain;

a second Fast Fourier Transform unit for converting the estimated channel impulse response padded with 0 (zero) into the frequency domain;

an address generator for generating an address by squaring a real number and a complex number outputs of the second Fast Fourier Transform unit and adding the squared numbers;

a ROM for pre-storing an inverse value of the channel impulse response and outputting an inverse value corresponding to an address of the address generator;

á multiplier for multiplying an output value from the ROM to the real number by the complex number of the second Fast Fourier Transform, respectively;

a complex multiplier for performing a complex-multiplication of a complex output value of the frequency domain receipt data outputted from the first Fast Fourier Transform unit with a complex output value of the multiplier;

an inverse Fast Fourier Transform unit for inverse-converting an output value from the complex multiplier into the time domain; and

a 2x → 1x converter for extracting only data of 1x block from the inverse Fast Fourier Transform unit.

7. The channel equalizer as claimed in claim 1, further comprising a noise removing unit for estimating an enhanced noise for the equalization from the output of the channel distortion compensation unit and for removing the enhanced noise and a vestigial symbol interference component contained in the time domain signal.

8. The channel equalizer as claimed in claim 7, wherein the noise removing unit comprises:

a noise predictor for estimating an enhanced noise by extracting only colored noise from the output of the channel distortion compensation unit; and

a subtracter for whitening the noise by subtracting the noise predicted by the noise predictor the output from the channel distortion compensation unit.

9. The channel equalizer as claimed in claim 7, wherein the noise removing unit comprises:

a selector for selecting the training sequence during the training period and a determined value of the noise-removed signal during the data block and outputting the selected signal as an original signal;

a first subtracter for extracting only the colored noise $v(n)$ by subtracting the output of the selector from the output of the channel distortion compensation unit;

a noise predictor for receiving and delaying an output from the first subtracter sequentially, predicting $v(n)$ by using the delayed value, and generating $\hat{v}(n)$;

a second subtracter for whitening the noise by subtracting the noise predicted $\hat{v}(n)$ in the noise predictor from the output of the channel distortion compensation unit; and

a determiner for determining the noise of which the enhanced noise is removed in the second subtracter and outputting the determined result to the selector.

10. A channel equalizer for restoring an original signal from a digital TV receiving signal having passed through a channel, comprising:

a channel estimation unit for estimating a finite impulse response estimation value of a channel by estimating an impulse response of a transmission channel from a received signal having passed through the channel;

a channel distortion compensation unit for compensating for the channel distortion of the received signal by using the time impulse response estimated in a frequency domain after converting the received signal and the estimated impulse response into the frequency domain, respectively, and for converting the received signal into a time domain again; and

a noise removing unit for estimating a noise enhanced during the equalizing from the output of the channel distortion compensation unit and for removing an enhanced noise and a vestigial symbol interference component contained in the time domain signal.

11. The channel equalizer as claimed in claim 10, wherein the channel estimation unit comprises:

a cross-correlation value generator for detecting a training time and calculating a cross-correlation value p(n) between a training sequence having passed through the channel during the training time and a predetermined training sequence at a receiver;

an instantaneous estimation unit for an instantaneous channel value $\hat{h}_i(n)$, (where $n = -N_{a,}\ -N_a+1,\ \cdots,\ 0,\ \cdots,\ N_c-1,\ N_c$) by matrix multiplication for estimating an instantaneous value by matrix multiplication of a coefficient of an inverse matrix R^{-1} of an autocorrelation matrix of the training sequence and the cross-correlation value; and

an estimation channel filter for calculating a mean value between a pre-stored estimation channel $\hat{h}(n-1)$ of a previous frame and a present instantaneous channel being outputted from the instantaneous channel $\hat{h}_i(n)$ estimation unit and outputting the mean value.

12. The channel equalizer as claimed in claim 11, wherein the cross-correlation value generator comprises:

a plurality of delayers, connected in serial as much as a training signal, for delaying the input signal sequentially;

a plurality of multipliers for multiplying outputs of the respect delayers by respect corresponding training signals t_i, $0 \le i \le L-1$; and

an adder for adding all the output of the respect multipliers and outputting the cross-correlation value p(n).

13. The channel equalizer as claimed in claim 11, wherein the instantaneous channel estimation unit comprises:

a ROM table for storing a coefficient of an inverse matrix R^{-1} of the autocorrelation matrix of the training sequence and outputting respect column values of R^{-1} in parallel;

a plurality of delayers, connected in serial, for delaying the cross-correlation value p(n) sequentially;

a plurality of multipliers for performing a matrix multiplication of the outputs of the respect delayers with the respect outputs of the ROM table; and

an adder for adding the outputs of the respect multipliers and outputting the instantaneous channel value $\hat{h}_i(n)$.

14. The channel equalizer as claimed in claim 11, wherein the estimation channel filter comprises:

n multipliers for storing an average impulse response estimation value of the previous frame;

a multiplier for multiplying the output of the delayer by a first coefficient β;

an adder for adding the output of the instantaneous channel estimation unit to the output of the multiplier and feeding the added result back the delayer; and

a multiplier for multiplying a second coefficient 1-β by an output of the adder and outputting the multiplied result to the channel distortion compensation unit.

15. The channel equalizer as claimed in claim 10, wherein the channel distortion compensation unit comprises:

a first Fast Fourier Transform unit for transforming the received signal from the time domain to the frequency domain;

a second Fast Fourier Transform unit for transforming the channel impulse response estimated in the channel estimation unit from the time domain to the frequency domain;

a ROM for storing inverse values of the channel impulse response transformed into the frequency domain in a form of table;

a multiplier for correcting the distortion of the received signal in the frequency domain outputted from the first Fast Fourier Transform unit by using a signal outputted from the ROM; and

an inverse Fast Fourier Transform unit for inverse-converting the signal in the frequency signal domain outputted from the multiplier.

16. The channel equalizer as claimed in claim 10, wherein the channel distortion compensation unit comprises:

a $1x \rightarrow 2x$ converter for enabling 2x Fast Fourier Transform by superposing a data block of a signal being received on a previous data block;

a zero padding machine for padding the estimated channel impulse response $\hat{h}(n)$ in the channel estimation unit with 0 (zero) to be suitable a 2x Fast Fourier Transform block;

a first Fast Fourier Transform unit for converting a 2x data block of the $1x \rightarrow 2x$ converter into the frequency domain;

a second Fast Fourier Transform unit for converting the estimated channel impulse response padded with 0 (zero) into the frequency domain;

an address generator for generating an address by squaring a real number and a complex number outputs of the second Fast Fourier Transform unit and adding the squared numbers;

a ROM for pre-storing an inverse value of the channel impulse response and outputting an inverse value corresponding to an address of the address generator;

a multiplier for multiplying an output value from the ROM to the real number by the complex number of the second Fast Fourier Transform, respectively;

a complex multiplier for performing a complex-multiplication of a complex output value of the frequency domain receipt data outputted from the first Fast Fourier Transform unit with a complex output value of the multiplier;

an inverse Fast Fourier Transform unit for inverse-converting an output value from the complex multiplier into the time domain; and

a 2x → 1x converter for extracting only data of 1x block from the inverse Fast Fourier Transform unit.

17. The channel equalizer as claimed in claim 16, wherein the zero padding machine adds a 0 (zero) value as much as 2M-N (where N is a length of the estimated channel impulse response) to a rear portion of the estimated channel impulse response when a block size that the first Fast Fourier Transform unit performs the Fast Fourier Transform is assumed to 2M.

18. The channel equalizer as claimed in claim 16, wherein the ROM stores the inverse value of the channel impulse response to be $ROM[A(k)] = \frac{1}{A(k)}$.

19. The channel equalizer as claimed in claim 10, wherein the noise removing unit comprises:

a noise predictor for estimating an enhanced noise by extracting only colored noise from the output of the channel distortion compensation unit; and

a subtracter for whitening the noise by subtracting the noise predicted by the noise predictor the output from the channel distortion compensation unit.

20. The channel equalizer as claimed in claim 10, wherein the noise removing unit comprises:

a selector for selecting the training sequence during the training period and a determined value of the noise-removed signal during the data block and outputting the selected signal as an original signal;

a first subtracter for extracting only the colored noise v(n) by subtracting the output of the selector from the output of the channel distortion compensation unit;

a noise predictor for receiving and delaying an output from the first subtracter sequentially, predicting v(n) by using the delayed value, and generating $\hat{v}(n)$;

a second subtracter for whitening the noise by subtracting the noise predicted $\hat{v}(n)$ in the noise predictor from the output of the channel distortion compensation unit; and

a determiner for determining the noise of which the enhanced noise is removed in the second subtracter and outputting the determined result to the selector.

21. The channel equalizer as claimed in claim 20, wherein the noise predictor comprises:

a plurality of delayers for delaying the output of the first subtracter sequentially;

a plurality of multipliers for multiplying the outputs of the respect delayers by respective predict coefficients; and

an adder for adding and outputting outputs of the respects multipliers.

22. A digital TV receiver utilizing a channel equalizer comprising:

a tuner for selecting a desired frequency of a channel by tuning when a vestigial sideband modulated signal is received through an antenna and converting the selected frequency into an intermediate frequency signal;

a demodulator for digitalizing the intermediate signal outputted from the tuner and demodulating the digitalized signal into a baseband signal;

a channel estimation unit for estimating a finite impulse response estimation value of a channel by estimating an impulse

response of a transmission channel from the output signal of the demodulator;

a channel distortion compensation unit for compensating for the channel distortion of the received output signal by using the time impulse response estimated in a frequency domain after converting the received output signal and the estimated impulse response into the frequency domain, respectively, and for converting the received output signal into a time domain again;

a noise removing unit for estimating a noise enhanced during the equalizing from the output of the channel distortion compensation unit and for removing an enhanced noise and a vestigial symbol interference component contained in the time domain signal; and

an error correcting unit for correcting a phase and error of data outputted from the noise removing unit and outputting the corrected data for decoding.

23. The digital TV receiver as claimed in claim 22, wherein the channel estimation unit comprises:

a cross-correlation value generator for detecting a training time and calculating a cross-correlation value p(n) between a training sequence having passed through the channel during the training time and a predetermined training sequence at a receiver;

an instantaneous estimation unit for an instantaneous channel value $\hat{h}_i(n)$, (where $n = -N_{a,} -N_a+1, \cdots, 0, \cdots, N_c-1, N_c$) by performing a matrix multiplication of coefficients of an inverse matrix R^{-1} of an autocorrelation matrix of a predetermined training signal and cross-correlation values; and

an estimation channel filter for calculating a mean value between a pre-stored estimation channel $\hat{h}(n-1)$ of a previous frame and a present instantaneous channel being outputted from the instantaneous channel $\hat{h}_i(n)$ estimation unit and outputting the mean value.

24. The digital TV receiver as claimed in claim 23, wherein the instantaneous channel estimation unit comprises:

a ROM table for storing a coefficient of an inverse matrix R^{-1} of the autocorrelation matrix of the training sequence and outputting respect column values of R^{-1} in parallel;

a plurality of delayers, connected in serial, for delaying the cross-correlation value p(n) sequentially;

a plurality of multipliers for performing a matrix multiplication of the outputs of the respect delayers with the respect outputs of the ROM table; and

an adder for adding the outputs of the respect multipliers and outputting the instantaneous channel value $\hat{h}_i(n)$.

25. The digital TV receiver as claimed in claim 22, wherein the channel distortion compensation unit comprises:

a first Fast Fourier Transform unit for transforming the received signal from the time domain to the frequency domain;

a second Fast Fourier Transform unit for transforming the channel impulse response estimated in the channel estimation unit from the time domain to the frequency domain;

a ROM for storing inverse values of the channel impulse response transformed into the frequency domain in a form of table;

a complex multiplier for correcting the distortion of the received signal in the frequency domain outputted from the first Fast Fourier Transform unit by using a signal outputted from the ROM; and

an inversed Fast Fourier Transform unit for inverse-converting the signal in the frequency signal domain outputted from the complex multiplier.

26. The digital TV receiver as claimed in claim 22, wherein the channel distortion compensation unit comprises:

a 1x $\rightarrow$ 2x converter for enabling 2x Fast Fourier Transform by superposing a data block of a signal being received on a previous data block;

a zero padding machine for padding the estimated channel impulse response $\hat{h}(n)$ in the channel estimation unit with 0 (zero) to be suitable a 2x Fast Fourier Transform block;

a first Fast Fourier Transform unit for converting a 2x data block of the 1x $\rightarrow$ 2x converter into the frequency domain;

a second Fast Fourier Transform unit for converting the estimated channel impulse response padded with 0 (zero) into the frequency domain;

an address generator for generating an address by squaring a real number and a complex number outputs of the second Fast Fourier Transform unit and adding the squared numbers;

a ROM for pre-storing an inverse value of the channel impulse response and outputting an inverse value corresponding to an address of the address generator;

a multiplier for multiplying an output value from the ROM to the real number by the complex number of the second Fast Fourier Transform, respectively;

a complex multiplier for performing a complex-multiplication of a complex output value of the frequency domain receipt data outputted from the first Fast Fourier Transform unit with a complex output value of the multiplier;

an inverse Fast Fourier Transform unit for inverse-converting an output value from the complex multiplier into the time domain; and

a 2x → 1x converter for extracting only data of 1x block from the inverse Fast Fourier Transform unit.

27. The digital TV receiver as claimed in claim 22, further comprising a noise removing unit for estimating an enhanced noise for the equalization from the output of the channel distortion compensation unit and for removing the enhanced noise and a vestigial symbol interference component contained in the time domain signal.

28. The digital TV receiver as claimed in claim 27, wherein the noise removing unit comprises:

a noise predictor for estimating an enhanced noise by extracting only colored noise from the output of the channel distortion compensation unit; and

a subtracter for whitening the noise by subtracting the noise predicted by the noise predictor the output from the channel distortion compensation unit.

29. The digital TV receiver as claimed in claim 27, wherein the noise removing unit comprises:

a selector for selecting the training sequence during the training period and a determined value of the noise-removed

signal during the data block and outputting the selected signal as an original signal;

a first subtracter for extracting only the colored noise v(n) by subtracting the output of the selector from the output of the channel distortion compensation unit;

a noise predictor for receiving and delaying an output from the first subtracter sequentially, predicting v(n) by using the delayed value, and generating $\hat{v}(n)$;

a second subtracter for whitening the noise by subtracting the noise predicted $\hat{v}(n)$ in the noise predictor from the output of the channel distortion compensation unit; and

a determiner for determining the noise of which the enhanced noise is removed in the second subtracter and outputting the determined result to the selector.